

MINOR RESEARCH PROJECT

PROJECT TITLE

Physico-Chemical analysis of water from Wahkharai stream, Umbir, Ri-Bhoi
District

No. F.5-101-2014-15/MRP/1802

FINAL PROJECT REPORT

SUBMITTED TO

The Joint secretary and Head
University grants commission
North- Eastern Regional Office (NERO)
3rd Floor, Housefed, Rental Block-V
Beltola-Basistha Road
Dispur, Guwahati
781006, Assam

By

Dr (Mrs) Cornelia Mary Lyngdoh
Principal Investigator
Department of Chemistry
Union Christian College
Umiam Khwan
Ri-Bhoi District
Meghalaya
793122

DECLARATION AND CERTIFICATE

I hereby declare that the Minor Research Project entitled “Physico-Chemical analysis of water from Wah-kharai stream, Umbir, Ri-Bhoi District” No. F.5-101-2014-15/MRP/1802 is a research work carried out by me during the year 2015-2017. I certify that the work presented in this report is original and carried out according to the plan in the proposal and guidelines of the University Grants Commission.


Principal Investigator

ACKNOWLEDGEMENT

I wish to express my gratefulness to the UGC – NERO, Guwahati for extending financial assistance to carry out this minor research project. I also express my heartfelt thanks to the former as well as present Principal, Union Christian College, Barapani, Meghalaya, for permitting me to conduct this research in the college. I also express my heartfelt thanks to Head, Department of Chemistry, for encouraging and providing Lab facility. I also express heartfelt thanks to Retired Prof. Ismail, Dept. of Chemistry, NEHU, Shillong, for his support, guidance, planning and execution phases of this study. I also express my thanks to all the teachers in the Department of Chemistry for their physical and moral support and also Scientists in the Pollution Control Board, Shillong for recording some of the experiments. I also express my sincere thanks to NEHU, Librarian and their support staffs for allowing me to use Library facility and reprints of some materials which was needed for this study.



Principal Investigator

ENCLOSURES

1. Certificate of Submission of Final Project Report and settlement of MRP by the College Principal.
2. Statement of Expenditure for the total expenditure incurred with countersigned by the Principal and Principal Investigator as per Annexure III as per XII Plan Guideline.
3. Statement of Expenditure incurred on field work with countersigned by the Principal and Principal Investigator as per Annexure IV as per XII Plan Guideline.
4. List of Books & Journals and Equipments.
5. Chartered Accountant audited and countersigned by the Principal and Principal Investigator Utilisation Certificate for the approved amount (i.e. Rs. 2,10,000/-).
6. Final report of the work done with countersigned by the Principal and Principal Investigator as per annexure VI as per XII Plan Guideline.
7. Proforma for submission of information at the time of sending the Final report of the work done on the project with countersigned by the Principal and Principal Investigator as per annexure VII as per XII Plan Guideline.
8. A summary of the project report (in 500 words).
9. Certificate of submission of Books & Journals and Equipments in the Department/Library by the College Principal.
10. Final report of the Project along with soft copy.


Principal Investigator



UNION CHRISTIAN COLLEGE

An Educational Project of the North East India Christian Council
Affiliated to the North-Eastern Hill University
Affiliation No. CD/A.5/94-95/1064-65 Dtd. December 13, 1995
'B' Grade Re-Accredited by NAAC

Dr. R.M. Manih
M.Sc., Ph.D.
Principal

Ref. No. UCC/MRP/2017-18/102

Date: 17th May, 2018

To,

The Joint Secretary
University Grants Commission
North Eastern Regional Office
Guwahati

Subj: Submission of Final Report and settlement of MRP.

Ref. No: F.5/101/2014-15/MRP/NERO/869 dated 19th April, 2018.

Sir,

With reference to the subject and the letter quoted above, I, do hereby submit the Final Report and Utilization Certificates against the grants released for the Minor Research Projects schemes against **Dr. Mrs. C. Lyngdoh** vide letter No. **F.5-101/2014-15/MRP/NERO/869** dated 5th March, 2015 Associate Professor Chemistry Department Union Christian College.

S/No.	Scheme	Name	Total
1.	Minor Research Project - Dr. Mrs. Comelia Mary Lyngdoh		Rs. 2,10,000

This is for your kind perusal and consideration.

Thanking you.

Encl: As stated

Yours faithfully

Dr. R.M. Manih
Principal

Principal
Union Christian College
Umiam Khwan
Ri-Bhoi District, Meghalaya

**UNIVERSITY GRANTS COMMISSION
BAHADUR SHAH ZAFAR MARG
NEW DELHI – 110 002**

STATEMENT OF EXPENDITURE IN RESPECT OF MINOR RESEARCH PROJECT

1. Name of Principal Investigator: Dr.(Mrs.) Cornelia Mary Lyngdoh
2. Deptt. of PI: Chemistry
Name of College: Union Christian College
3. UGC approval Letter No. and Date: F.5-101-2014-15/MRP/NERO/1802 of dated 09 Feb. 2015.
4. Title of the Research Project: Physico-Chemical analysis of water from Wah Kharai stream, Umbir, Ri Bhoi Distric
5. Effective date of starting the project: 02 June 2015
6. a. Period of Expenditure: From June 2015 to June 2017
b. Details of Expenditure: Rs. 1,82,141.00

S.No	Item	Amount Approved (Rs)	Expenditure Incured (Rs)
i.	Books & Journals	30,000/-	27,000/-
ii.	Equipment	90,000/-	83,531/-
iii.	Contingency including special needs	20,000/-	13,200.00 + 4450.00.00 = 17650.00
iv.	Field Work/Travel (Give details in the proforma)	20,000/-	13,000.00 + 4000.00 = 17000.00
v.	Hiring Services and fee for experiments conducted at pollution control Board, Shillong		5,400.00 + 8,870.00 = 14270.00
vi.	Chemicals & Glassware	50,000/-	20,710.00 + 2000.00 = 22,710.00
		2,10,000/-	1,62841+ 19320.00 = 1,82,161.00

Principal
Union Christian College
Ri Bhoi Dist. J. P. N. W. in
Meghalaya.

7. if as a result of check or audit objection some irregularly is noticed at later date, action will be taken to refund, adjust or regularize the objected amounts.

8. It is certified that the grant of Rs. 2,10,000/- (Rupees two ten thousand only) received from the University Grants Commission under the scheme of support for Minor Research Project entitled Physico-Chemical analysis of water from Wah Kharai, stream, Umbir, Ri Bhoi Distric vide UGC letter No. F. 5-101-2014-15/MRP/NERO/1802 of dated 09 Feb. 2015 has been fully utilized for the purpose for which it was sanctioned and in accordance with the terms and conditions laid down by the University Grant Commission.


SIGNATURE OF PRINCIPAL INVESTIGATOR


PRINCIPAL

Principal
Union Christian College
Umiam Khasi
Ri-Dhoi D. (Seal)
Meghalaya.

**UNIVERSITY GRANTS COMMISSION
BAHADUR SHAH ZAFAR MARG
NEW DELHI – 110 002**

STATEMENT OF EXPENDITURE INCURRED ON FIELD WORK

Name of the Principal Investigator: Dr. (Mrs.) Cornelia Mary Lyngdoh

Name of the Place visited	Duration of the Visit		Mode of Journey	Expenditure Incurred (Rs.)
	From	To		
1. NEHU Library	UCC (8 times)	NEHU, Umshing	Hiring Taxi	8 X 350.00 = 2800.00
	NEHU, Umshing	UCC	Hiring Taxi	8 X 350.00 = 2800.00
2. NEC Library	UCC (2 times)	Nongrim Hills	Hiring Taxi	2 X 350.00 = 700.00
	Nongrim Hills	UCC	Hiring Taxi	2 X 350.00 = 700.00
3. Pollution Controlled Board	UCC (4 times)	<u>Lumpynggad</u>	Hiring Taxi	4 X 400.00 = 1600.00
	<u>Lumpynggad</u>	UCC	Hiring Taxi	4 X 400.00 = 1600.00
4. <u>Wah Kharai stream, Umbir</u>	Shillong (6 times)	Wah Kharai stream and UCC	Hiring Taxi	6 X 700.00 = 4200.00
	UCC (2 times)	Wah Kharai stream	Hiring Taxi	2 X 400.00 = 800.00
	UCC (4 times)	Wah Kharai stream	Hiring Taxi	4 X 450.00 = 1800.00
				Total = 17000.00

Certified that the above expenditure is in accordance with the UGC norms for Minor Research Projects.


SIGNATURE OF PRINCIPAL INVESTIGATOR



PRINCIPAL

Principal
Union Christian College
Umiam

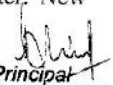
(Seal)

List of Books and Journals and Equipments


1. Guidelines for drinking water quality, World Health Organisation, Geneva, Vol. 2, 1999.
2. Guidelines for drinking water quality, World Health Organisation, Geneva, 1993.
3. I.L. Marr and M.S. Cresser, Environmental Chemical Analysis, International Textbook Co., Glasgow (1983).
4. D.F.S. Natusch and P.K. Hopke, Analytical Aspects of Environmental Chemistry, John Wiley and Sons, New York (1983)
5. S.E. Manahan, Environmental Chemistry, CRC Press, USA, 6th ed.(1984).
6. Eugene W. Rice, Rodger B. Baird, Andrew D. Eaton, Lenore S. Clesceri, 'Standard Methods for the examination of Water and Wastewater' 22nd edition, APHA, AWWA, WEF 2012.
7. Bhatt, S. D., Pathak, J.K., Himalayan Environment: Water quality of drainage basins, Shree Almora Book Depot, Almora, pp 318, 1992.
8. Pathani, S.S, Impact of changing aquatic environment on the snow froot of Kumaun Himalayas: Ministry of environment and Forest, New Delhi, pp53, 1995.
9. Gupta, Sanjay, Bhatnagar, M. K., Singh Raviraj and Bhatanagar Prachi, " Studies on Physico- Chemical parameters of Bansagar dam and Nearby area Madhya Pradesh, India, International Journal of Latest Research in Science and Technology. Vol 2(3) pp 20-22, 2013.
10. Panda, R.B., Pradhan, D and Pande, L. K., Water quality of the Brahmani River- An analytical study upstream, Mid stream, Down stream at Effluent Discharge point of Talcher Industrial complex, Orissa, India, Journal of Industrial Pollution Control 25(1), 1-6, 2009.
11. Anand Singh Bisht, Gulam Ali, D. S. Rawat and N, N, Pandey, Physico-Chemical behaviour of the three different water bodies of sub-tropical Himalayan Region of India, Journal of Ecology and the Natural Environment 5(12) 387-395, 2013.
12. R. Khare, S. Khare, M. henmical analysis of Ganga river water, Asian Journal of Biochemical and pharmaceutical Research 1, 232-239, 2011.
13. Srivastava, P.K., Mukherjee, S., Gupta, M. and Singh, S.K., Characterising Monsoonal Variation on water quality Index of River Mahi in India using Geographical Information system, Water Quality Expo Health, 2, 193-203, 2001.


Principal
Union Christian
Mission
Ri-Bhoi D

14. Mahananda, M. R., Physico-Chemical analysis of surface water and ground water of Bargarh District, Orissa, India, *International Journal of Research and Review in Applied Sciences*, 2(3), 284-295, 2010.
15. Grasby S.E., Hutcheon, I. and Krouse, H.R., Application of the stable isotope composition of SO_4^{2-} to tracing anomalous TDS in Nose Creek, southern Alberta Sulphate, Canada, *Applied Geochemistry*, 12 (5) 567-575, 1997.
16. Trivedi, R.K and Goel, P. K. , 1984, Chemical and biological methods for water pollution studies, Environmental Publications, Karad.
17. Zare Gariz, A., Sheikh, V., and Sadoddin, A., Assessment of seasonal variations of chemical characteristic in surface water using multivariate statistical methods, *International Journal of Environment Science and technology* 8(3) 581-592, 2011.
18. Panda, R.B., Pradhan, D. and Panda L.K., Water quality of the Brahmani river – an analytical study upstream, midstream, downstream at effluent discharge point of talcher industrial complex, Orissa, India. *Journal of Industrial Pollution Control* 25(1) 1-5, 2009.
19. Thresh J.C., Beale J. F., and Suckling E. V., The examination of water and water supplies B. W. Taylor, London 1949.
20. Ownby C. R. And Kee, D.A.: Chloride intake Eric. *Proc. Cong. Great Lakes*, 382-389, 1968.
21. Trivedi P., Bhajpal A. and Thereja S. Comparative study of seasonal variations in water. *Nature Sci.* 8, 4, 2010.
22. Bansal, S. K., Haldar, N., Dhand, U. K. et al. Phrenic neuropathy on arsenic poisoning. *Int. J. Dermatol.* 30, pp 304-306, 1991.
23. Food and Agriculture Organization (FAO). World Health Organization (WHO). *WHO Food Addit, Ser.* 18. 1983.
24. Fennel, J. S., and Stacy, W. K. Electrocardiographic changes in acute arsenic poisoning. *Ir. J. Med. Sci.* 150, pp 338-339, 1981
25. Goldsmith, S., and From, A. H. Arsenic-induced atypical ventricular tachycardia. *N. Engl. Med.* 303, pp 1096-1097, 1986.
26. Moore M. R., Haematological effects of lead. *Sci Total Environ*, 1988 (71) 419-431.
27. Wildt K. Eliasson R, Borlin M. Effect of occupational exposure to lead on sperm and semen In: Claebson T. W., Nordberg G.F. Sagar P.R., editors. Reproductive and developmental toxicity of metals. Proceeding of joint meeting in Rochester, New York: Plenum press, 279-300, 1983


Principal
Union Christian College
Umiyam Khuntia
Ri-Bhoi District, Meghalaya

28. Cullen M.R., Kayne R. D., Robin J. M., Endocrine and reproductive in men a social with occupation inorganic lead intoxication. Arch Environ Health. 1984(39) 431-440.
29. International Agency for Research on cancer. Some metals and metallic compounds. Lyon, 1980, 205-323 (IARC Monographs on the Evaluation of the Carcinogenic risk, of Chemicals to Humans, Vol 23).
30. International Agency for Research on Cancer. Chromium and nickel. Lyon, (IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Vol 49), 1990.
31. Trivedi et al. Comparative study of seasonal variation in water. Nature and science 8(4) 2010.
32. Cohen JM et al. Taste threshold concentrations of metals in drinking water. Journal of American Water Work Assoc., 52, 660-670, 1960.
33. Water Works Association, 52:660,1960. Elinder CG. Zinc. In: Friberg L, Nordberg GF, Vouk VB, eds. Handbook on the toxicology of metals, 2nd ed. Amsterdam, Elsevier Science Publishers, 664-679, 1986
34. International Organization for Standardization: Water quality—determination of cobalt, nickel, copper, zinc, cadmium and lead—flame atomic absorption spectrometric methods. Geneva, 1986 (ISO 8288:1986).
35. Stumm W, Morgan JJ (1996) *Aquatic chemistry*. New York(NY), Wiley Interscience.
36. IPCS (1998) *Copper*. Geneva, World Health Organization, International Programme on Chemical Safety (Environmental Health Criteria 200).
37. Sarwar, S, K. And Irfan-UI-Majid., Abiotic features and diatom population of Wular lake Kashmir. Ecol. Env and Cons 3(3)121-128 (1997).
38. Wright, R, Seasonal variation in water quality of a West African river (R Jong in Sierra Leone) Revue d'Hydrobiologie Tropicale 15(3), 193-199 (1982).
39. Gupta, R.K., Sharma, M., Gorai, A.C. and Pandey, P.N., Impact of Coal Mining Effluents on the physico-chemical characteristics of Raja Tank, Jaria (Dhanbad). J. Freshwater Bio 8(2) 63-73, 1996.
40. Gupta, A. K. And Malhotra, R.S., Ecological studies on water mould of kurukshetra: in current trends in Limnology1: 47-64, 1991.
41. Das, S.M. High pollution in lake Nainital (U.P) as evidenced by biological indicators. Science and Culture 44: 236-237, 1978
42. Das. S.M. and Pandey, J., Pollution, Fish mortality and Environmental parameters in lake Nainital,. J. Bombay Nat. Hist. Soc 79: 100-109, 1980.


 Principal
 Union Christian College
 Umiam Khyan
 Ri-Bhoi District Meghalaya

EQUIPMENT

WATER ANALYSER 371

SYSTRONICS (An ISO 9001: 2008 Co.



SIGNATURE OF PRINCIPAL INVESTIGATOR



PRINCIPAL
Principal
Union Christian College
Umiam Khasi
Ri-Bhoi District, Meghalaya

(Seal)


Annexure - V

UNIVERSITY GRANTS COMMISSION
BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110 002


Utilization certificate

Certified that the grant of Rs. 1,65,000/- (Rupees one lakh sixty five thousand only) received from the University Grants Commission under the scheme of support for Minor Research Project entitled Physico-Chemical analysis of water from Wah Kharai, stream, Umbir, Ri Bhoi District vide UGC letter No. F.5-101/2014-15/MRP/NERO1802 of dated 09 Feb 2015 has been fully utilized for the purpose for which it was sanctioned and in accordance with the terms and conditions laid down by the University Grants Commission.


SIGNATURE OF THE
PRINCIPAL INVESTIGATOR


PRINCIPAL
Principal
Union Christian College
Ri - Bhoi Dist.
Meghalaya
(Seal)

STATUTORY AUDITOR
For D. Das & Associates
Chartered Accountants

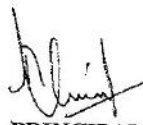

Debaraj Das
(Partner)

UNIVERSITY GRANTS COMMISSION
BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110 002

Utilization certificate

Certified that the grant of Rs. 19,320.00 (Rupees nineteen thousand three hundred twenty only) received from the University Grants Commission under the scheme of support for Minor Research Project Entitled Physico - Chemical analysis of water from Wah Kharai, stream, Umbir, Ri Bhoi District vide UGC letter No. F. 5-101/2014-15/MRP/NERO1802 dated 09 Feb 2015 has been fully utilized for the purpose for which it was sanctioned and in accordance with the terms and conditions laid down by the University Grants Commission.

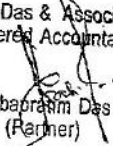

SIGNATURE OF THE
PRINCIPAL INVESTIGATOR


PRINCIPAL
Principal
University Grants Commission
Bahadur Shah Zafar Marg
New Delhi - 110 002

(Seal)

STATUTORY AUDITOR

For D. Das & Associates
Chartered Accountants



Debabrta Das
(Partner)

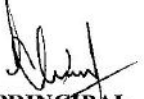
(Seal)

UNIVERSITY GRANTS COMMISSION
BAHADUR SHAH ZAFAR MARG
NEW DELHI – 110 002.

Annual/Final Report of the work done on the Minor Research Project.
(Report to be submitted within 6 weeks after completion of each year)

1. Project report No. 1st/ Final: Final
2. UGC Reference No: F. 5-101-2014-15/MRP/NERO/1802
3. Period of report: from June 2015 to June 2017
4. Title of research project: Physico - Chemical analysis of water from Wah Kharai stream, Umbir, Ri Bhoi District
5. (a) Name of the Principal Investigator: Dr(Mrs) Cornelia Mary Lyngdoh
(b) Deptt.: Chemistry
(c) College where work has progressed: Union Christian College (UCC)
6. Effective date of starting of the project: June- 2015
7. Grant approved and expenditure incurred during the period of the report:
 - a. Total amount approved Rs. 2,10,000/-
 - b. Total expenditure Rs. (1,62,841.00 + 19,320.00) = 1,82,161.00
 - c. Report of the work done: (Please attach a separate sheet)
 - i. Brief objective of the project: To study water quality in and around UCC and to provide information to the local people particularly to the UCC communities.
 - ii. Work done so far and results achieved and publications, if any, resulting from the work (Give details of the papers and names of the journals in which it has been published or accepted for publication: Preparing manuscript for publication.
 - iii. Has the progress been according to original plan of work and towards achieving the objective. if not, state reasons: The progress has been according to the original plan of the work, some extra parameters were also included which was not in the original plan.
 - iv. please enclose a summary of the findings of the study. One bound copy of the final report of work done may also be sent to the concerned Regional Office of the UGC.
 - v. Any other information

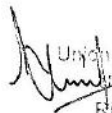

SIGNATURE OF THE
PRINCIPAL INVESTIGATOR


PRINCIPAL
Principal
Union Christian College
Umbir Bhoi
Ri-Bhoi District
Meghalaya.
(Seal)

UNIVERSITY GRANTS COMMISSION
BAHADUR SHAH ZAFAR MARG
NEW DELHI – 110 002

PROFORMA FOR SUBMISSION OF INFORMATION AT THE TIME OF SENDING
THE FINAL REPORT OF THE WORK DONE ON THE PROJECT

1. Title of the Project: Physico - Chemical analysis of water from Wah Kharai stream, Umbir, Ri Bhoi District
2. NAME AND ADDRESS OF THE PRINCIPAL INVESTIGATOR :
DR(MRS) CORNELIA MARY LYNGDOH,
DEPARTMENT OF CHEMISTRY, UNION
CHRISTIAN COLLEGE, UMIAM KHWAN, RI-BHOI
DISTRICT, MEGHALAYA, PIN -793122
3. NAME AND ADDRESS OF THE INSTITUTION: UNION CHRISTIAN COLLEGE
UMIAM KHWAN, RI-BHOI DISTRICT,
MEGHALAYA, PIN -793122
4. UGC APPROVAL LETTER NO. AND DATE: F. 5-101-2014-15/MRP/NERO/1802
DATE: 09 FEBRUARY 2015
5. DATE OF IMPLEMENTATION: JUNE 2015
6. TENURE OF THE PROJECT : 24 MONTHS
7. TOTAL GRANT ALLOCATED: RS: 2,10,000/
8. TOTAL GRANT RECEIVED: RS 1,65,000/-
9. FINAL EXPENDITURE : RS. 1,82,161.00
10. TITLE OF THE PROJECT: PHYSICO CHEMICAL- ANALYSIS OF
WATER FROM WAH KHARA STREAM,
UMBIR, RI-BHOI DISTRICT.
11. OBJECTIVES OF THE PROJECT: TO STUDY WATER QUALITY IN AND
AROUND UCC AND TO PROVIDE
INFORMATION TO THE LOCAL PEOPLE
PARTICULARLY TO THE UCC
COMMUNITIES.
12. WHETHER OBJECTIVES WERE ACHIEVED: THE OBJECTIVE OF THE STUDY
(GIVE DETAILS) HAS BEEN COMPLETED SUCCESSFULLY
13. ACHIEVEMENTS FROM THE PROJECT: MAHUSCRIPT IS IN THE PROCESS
FOR COMMUNICATION, ONE ORAL
PRESENTATION TO THE COLLEGE
STUDENTS


Principal Investigator
Union Christian College
Umiakhwan, Ri-Bhoi District
Meghalaya

14. SUMMARY OF THE FINDINGS:
(IN 500 WORDS): REPORT ENCLOSED
15. CONTRIBUTION TO THE SOCIETY: REPORT ENCLOSED
16. WHETHER ANY PH.D. ENROLLED/PRODUCED OUT OF THE
PROJECT: NO
17. NO. OF PUBLICATIONS OUT OF THE PROJECT: IN THE PROCESS
PLEASE ATTACH)



(PRINCIPAL INVESTIGATOR)



(PRINCIPAL)

Principal
Union Christian College
Umiam, Jorhat
Ri-Bhor District
Meghalaya.

(Seal)

SUMMARY OF THE FINDINGS

The study was conducted to analyse the quality of water of Wah Kharai stream, Umbir, Ri Bhoi District, Meghalaya. Water samples were collected from twelve different places in the months of June, August, October, December, February and April. The samples were analysed for temperature, pH, conductivity, turbidity, TDS, salinity, DO, SO_4^{-2} , NO_3^- , Cl^- , F^- , PO_4^{-3} , As, Hg, Pb, Cd, Cr, Fe, Zn, Cu, Acidity, Alkalinity, BOD, COD etc. The analysed result indicates that the water samples do not cross the maximum permissible limit prescribed by WHO and therefore the consumption of water from this stream is not exposed to health risks at the moment. The present study indicates that the pollution level in this area is not high. However, the pH values decrease to the minimum permissible limits in the winter.

As per the proposal submitted, I had completed the findings. Water samples were collected in the months of June, August, October, December, February and April, recorded and further analysed them. The analysed parameters were temperature, pH, Conductivity, Turbidity, Total dissolved solids (TDS), Salinity, Dissolve oxygen(DO), Sulphate (SO_4^{-2}), Nitrate (NO_3^-), Chloride (Cl^-), Fluoride(F^-), Phosphate(PO_4^{-3}), Arsenic (As), Mercury(Hg), Lead(Pb), Cadmium(Cd), Chromium(Cr), Iron(Fe), Zinc(Zn), Copper(Cu), Acidity, Alkalinity, Biological Oxygen Demand(BOD) and Chemical Oxygen Demand(COD). Parameters like Temperature, pH, Conductivity, Dissolve Oxygen (DO), Salinity, Total Dissolved Solids (TDS), Turbidity etc. were recorded on the spot by using water analyser 37F, Systronics and all other parameters were recorded by using the procedures described in the Standard Methods for the Examination of Water and Wastewater (APHA 2000, 22nd ed.) and also different water testing kits to compare the results (AQUA CHECK, Himedia Laboratories Pvt. Ltd. India). The preparation of the required solutions for all the experiments was done in accordance with the standard methods described. The results are presented in table 01 to 22. Temperature ranged from 15.8 to 24.4°C, it was observed that the values are minimum in the winter and maximum in the summer. The pH values ranged from 6.58 - 8.09 throughout the investigation period and critically observed that the value goes down to minimum 6.58 in the winter season. The conductivity values ranged from 38.0 to 211 $\mu\text{S}/\text{cm}$, the turbidity values ranged from 0.01 to 0.07NTU, the total dissolved solids (TDS) ranged

from 24.6 to 135(ppm), and the salinity ranged from 0.01 to 0.09(ppt), it observed that the above three values are higher during rainy season and lower in the winter. The dissolved oxygen (DO) ranged from 6.48 to 6.95(ppm). Some of the measured radicals are sulphate (SO_4^{2-}), it ranged from 0.01 to 0.05ppm, nitrate (NO_3^-)- below detectable level, chloride ranged from 0.01 to 0.012ppm. All the values of the parameters like Fluoride, phosphate, arsenic, mercury, lead, cadmium, chromium, iron, zinc, copper are below detectable level. Acidity values 02.0(mg/l) and the alkalinity ranged from 06.0 to 16.0(mg/l).

CONTRIBUTION TO THE SOCIETY

Exposure to new scientific field is good for all of us in developing our skills particularly students. In the present study, B.Sc. Chemistry (Hon's) students were actively involved in collection of water samples from the stream, preserving the samples for further analysis, handling the balance to measure various chemicals at the milligram level, preparation of required solutions for different experiments, titration, estimation etc. The students were also taught the handling of the instruments and the theory behind the instruments. This opportunity helped them in developing their analytical skills in various areas. Students were taught the necessity of measurements and recording of some of the parameters on the spot. The observed values were shown to them and explained its significance. Students were also taught the specific meaning of portable water and its importance in the society.

This study further reveals to the people of nearby villages and Union Christian College community in particular that the water of this stream is safe for drinking and for daily activities.



UNION CHRISTIAN COLLEGE

An Educational Project of the North East India Christian Council

Affiliated to the North-Eastern Hill University

Affiliation No. CD/A.5/94-95/1064-65 Dtd. December 13, 1995

'B' Grade Re-Accredited by NAAC

Dr. R.M. Manih
M.Sc., Ph.D.
Principal

CERTIFICATE OF SUBMISSION OF

BOOKS, JOURNALS AND EQUIPMENTS IN LIBRARY & DEPARTMENT

This is to certify that **Dr Cornelia Mary Lyngdoh** had submitted all the relevant **Books, Journals and Equipments** related to her Minor Research Project to the Department of Chemistry and Library of Union Christian College.

Date : 17th May, 2018

Principal

Union Christian College

Umiam

Principal

Union Christian College

Umiam Khwan

Ri-Bhoi District, Meghalaya



CONTENTS

Sl. No.	Item	Page No.
01	Introduction, Significance of the proposed study	01
02	Methodology: Sample Collection and Preservation, Materials, Preparation of required solution	03
03	Methods of Analysis	04
04	Results and Discussion	05
05	Conclusion and recommendation	12
06	Table 1-8 - Data on Temperatures, pH, Conductivity, Turbidity, Total dissolved solids (TDS), Salinity and dissolved oxygen (DO)	13
07	Table 9-13 - Data on Sulphate, nitrate, chloride, fluoride and phosphate	17
08	Table 14-21 - Data on Arsenic, Mercury, Lead, Cadmium, Chromium, Iron, Zinc and copper	20
09	Table 22 –Data on Acidity, Alkalinity, BOD, COD	23
10	References	24
11	Appendix 1 - Photographs of Water Source	28

1. INTRODUCTION

Shillong, the capital of Meghalaya is known as Scotland of the East and is well known for its natural beauty and good water. The Umiam lake, one of its tourist spots for the past many years was crystal clear but with the increase in population and lack of awareness of the inhabitants has lost its beauty and cleanliness. The domestic waste from maximum household, buildings, business establishments, small industries, hospitals etc. is disposed off into open drains, consequently it enter into the streams, rivers and ultimately collected at Umiam lake. The fishes and living organisms in the lake are slowly dying and on the verge of extinction. As we all know that water is the most important life sustaining drink to animals, humans and also is essential to the survival of all the organisms¹. The original source of drinking water is rich in aquatic microbes². It could be dangerous if they enter to humans. Therefore, clean and unpolluted water needs for the men's continual existence and to prevent immense harm to public health³. To get acceptable water quality for our consumption and daily activities, it is necessary to monitor water periodically^{4,5}. There is an urgent need for thorough testing of water quality in and around Union Christian College area for the benefit of the inhabitants (students, staff and neighbouring village people around the area). Water quality may vary with the locality, activities of the peoples and the geographical factors. Wahkharai stream flows in close proximity to Union Christian College (UCC). In fact it is life line of Union Christian College community and also the surrounding village. The stream water is reserved in the reservoir inside the college campus and supply to the respective hostels, teaching and non-teaching staff quarters, canteens and to the science laboratories. The stream is very far from the industrial establishment, agricultural lands and also thinly populated around. This water is used for various human activities. This study includes the measurements of temperature, pH, conductivity, turbidity, TDS, salinity, DO, SO_4^{2-} , NO_3^- , Cl^- , F^- , PO_4^{3-} , As, Hg, Pb, Cd, Cr, Fe, Zn, Cu, Acidity, Alkalinity, BOD, COD etc. This will give some important conclusions to predict the quality of water.

2. Significance of the proposed study: Water analysis is the process of finding standard acceptable drinking water and its source. Consumption of polluted water is at high risk immediately or long term to the animals and humans. Polluted water may also harm the aquatic life as well. Therefore, it is necessary to consume clean and unpolluted water to avoid waterborne diseases and also improper functioning of specific organs from the long time

consumption of excess essential elements. The suspended particles, oxygen demanding particles/materials, dissolved inorganic and organic compounds and also harmful bacteria found in municipal wastewater may be reduced by proper treatments. Hence, water is required to purify to the acceptable stage by some specific treatment depending upon the sources before use. The quality of water may differ from place to place due to several factors. The presence of microorganism may change the drinking water quality and also the aquatic life. What are the microorganisms present in the waste particles and what are their role to get the better water quality for different users can be ascertained / concluded from water analysis. The presence of microorganisms may response to the environmental conditions on various aspects and may draw the attention of the destruction of ecosystem. One can study deeply the changes occurring in the environment and can be concluded the harmful pollutants present in the environment. Several investigators have studied water quality parameters in different parts of Shillong, but none have studied the Wahkharai stream, the water source of Union Christian College community. Some physico-chemical parameters like temperature, pH, conductivity, turbidity, TDS, salinity, DO, SO_4^{-2} , NO_3^- , Cl^- , F^- , PO_4^{-3} , As, Hg, Pb, Cd, Cr, Fe, Zn, Cu, Acidity, Alkalinity, BOD, COD etc. determine the quality of water. It has been proposed to analyse Wahkharai stream water in twelve different locations.

3. Methodology:

i) **Sample Collection and Preservation:** The water samples were collected in sampling bottles from twelve different locations every two months during the study period. All the samples were collected during day time from 10.00A.M to 3.00P.M. Collection was done in accordance to standard norms adopted and proper levelling of the samples was done to avoid sample misidentification. Some parameters were analysed on the spot immediately after the collection of the samples by using the portable instrument and for other analysis, the sample preservation was done by using standard norms.

ii) **Materials:** The chemicals used for this investigation are from the MERCK India, Loba chemicals Pvt. Ltd, Sd fine-chem limited, HiMedia laboratory, Sigma Laboratories Pvt. Ltd.

iii) **Preparation of required solution:** Preparation of required solutions for analysis was done in accordance to the procedures described on 'Standard Methods for the examination of

Water and Wastewater’ 22nd edition, APHA, AWWA, WEF 2012. **sis of Samples:** Analysis of the collected water samples was done in accordance with the procedures described in the Standard Analytical Procedure Manual for water samples which is based on⁶ ‘Standard Methods for the examination of Water and Wastewater’ 22nd edition, APHA, AWWA, WEF 2012 (alkalinity-titrimetrically, BOD - bottle incubation for 5days at 20°C, COD, open reflux, NO₃, PO₄ — spectrophotometric, Cl—argentometric titration and metals — atomic absorption spectrometer.

Temperature, pH, Conductivity, DO, TDS, Salinity, Turbidity were analysed and recorded by using Water Analyser 371Systronics on the spot while some of the sample analysis was done in accordance with the procedures described in the Standard Analytical Procedure for the Examination of Water and Wastewater APHA 22nd ed. Some experiments were also carried out in the laboratory for comparison of results by using AQUA CHECK, water analysis system, HiMedia Laboratories Pvt. Ltd. Preparation of the required solutions was done in accordance with the manual of the instrument (water analyser 371) and APHA 22nd edition.

Methods of analysis:

Sl.No.	Parameters	Methods	Instrument
01	Temperature		WaterAnalyser 371Systronics
02	pH		Water Analyser 371Systronics
03	Conductivity		Water Analyser 371Systronics
04	Turbidity		Water Analyser 371Systronics
05	TDS		Water Analyser 371Systronics
06	Salinity		Water Analyser 371Systronics
07	DO		Water Analyser 371Systronics
		APHA 22 nd Ed. WEF 2012	
08	Sulphate	UV-Vis Spectrophotometric	UV-Vis. Spectrophotometre
09	Nitrate	UV-Vis Spectrophotometric	
10	Chloride	Argentometric titration	
11	Fluoride	And AQUA CHECK, HiMedia Laboratories Pvt. Ltd.for comparison	

12	Phosphate	Vis Spectrophotometric screening method. And AQUA CHECK, HiMedia Laboratories Pvt. Ltd. For comparison	
13	Arsenic (mg/l)	3030 – E, 3111B	
14	Mercury(mg/l)	3030 – E, 3111B	
15	Lead(mg/l)	3030 – E, 3111B	
16	Cadmium(mg/l)	3030 – E, 3111B	
17	Chromium(mg/l)	3030 – E, 3111B	
18	Iron($\mu\text{m/l}$)	3030 – E, 3111B	
18	Zinc ($\mu\text{m/l}$)	3030 – E, 3111B	
19	Copper ($\mu\text{m/l}$)	3030 – E, 3111B	
20	Acidity(mg/l)	2310-B	
21	Alkalinity(mg/l)	2320-B	
22	BOD(mg/l)	IS-3025(p-44)	
23	COD	5220-C	

Results and Discussion:

Temperature: Temperature is one of the most important physical parameters that regulate the metabolism of the aquatic life. Higher water temperature reduces the ability of water to hold the dissolved oxygen gas; as a result the aquatic life may be more stress. It effects the chemical and biochemical characteristic of the water body. The maximum temperature was recorded in the month of June and the minimum temperature was recorded in the month of December. Similar observations were reported in the literature⁷⁻⁹. In the present study, the temperature was found in the range 15.8°C to 24.4°C, shown in table 1. The significant variation was observed from summer to winter during the study period. Some minor variations were also observed among the different spots. These variations could be due to large variations in volume of water and also the collection time of the samples.

pH: pH is one of the most important physical parameters to indicate the acidic or basic character of water bodies. It determines the hydrogen ion concentration in a solution. In the present study, it was found that the pH values of water bodies ranged from 6.58 to 8.09 in all the seasons. It is slightly acidic in winter and alkaline in rainy season. It could be due to non-pollutants of organic substances in the water. The variations of the pH were observed during the study period. All the samples were found to be within the limit in accordance with World Health Organisation. The alkalinity ranged from 12 mg/l to 16.0 mg/l which is not far away from the portable water quality. The low value of alkalinity could be due to absence of carbonate, bicarbonate and hydroxides⁹. The values are within the permissible limits of 120mg/l(WHO).

Conductivity: The conductivity of water is an indicator of water quality problem. It is determined by the concentration of the various ions present in it. The more the concentration of ions in the water sample the more is its conductivity. If the conductivity of water sample increases, it indicates that there is a specific source of ions in the water body. The amount of ions present in water sample is directly proportional to the total amount of solids dissolved¹⁰. The number of cations present in the sample is due to the decomposition and mineralization of organic materials¹¹. The ions present in the sample are mainly from the decomposed plant matter¹². The conductivity was recorded from 12 different spots and it was observed that the values range from 38.0 μScm^{-1} to 211 μScm^{-1} . The values are higher in rainy season and lower in winter season. This indicated that the ions were liberated more in the rainy season than winter.

Turbidity: Turbidity indicates the amount of suspended particles present in water body. The major contributing matters to turbidity are suspended clay, organic matter etc. The turbidity values observed from 12 different spots are presented in table 6. The values range from 0.01NTU to 0.07NTU. The concentration of turbidity is higher in the rainy season and decrease in the winter because it settled all the suspended particles¹³.

Total Dissolved Solids: The TDS were recorded from 12 different spots and the values ranged from 24.6 ppm to 135.0ppm. The lowest value of TDS was found in the winter and the highest value was found only in the post rainy season. The total dissolved solids in water are the compounds of chlorides, phosphates, carbonates and bicarbonates and nitrates of potassium, manganese, magnesium, sodium, calcium and also organic compounds, salts etc¹⁴.

It indicates that in rainy season most of the solids were dissolved in water. The values are within the permissible limits (WHO).

Salinity: Salinity is the measure of amount of salts present in the water body. The dissolved ions increase salinity as well as the conductivity of water. The dissolved ions such as sodium ions, chloride, carbonate and sulphate are responsible for high salinity of water⁴⁴. The salinity and the conductivity are directly related each other. Salinity affects the quality of water used for drinking. It also affects the lives of all the organisms because the entire organism has specific range to tolerate. In fact, scholars measured the salinity of water by determining the amount of chlorine present in water body⁴⁵. The salinity was recorded from 12 different spots and the values ranges from 0.01ppt to 0.09ppt. This value indicates that the amount of the ions present in water body is very low.

Dissolved Oxygen (DO): Dissolved oxygen is one of the most important parameters used to predict the quality of water¹⁶. In fact, it reflects the physical and biological processes prevailing in the water. It is one of the most important parameters for the growth and survival of aquatic lives. The DO was recorded from 12 different spots and it was observed that the values range from 6.48ppm to 6.95ppm. The values are neither too low nor too high and indicate that the water is not significantly polluted. The values are high in summer and low in winter. There may be some small amount of organic matters in the water body from the leaves, grass and also dead plants. The maximum values of DO were recorded as 6.95ppm in summer while the minimum values were recorded as 6.48ppm in winter. The DO values were high in summer due to photosynthesis. The values are in agreement with reports available in the literature.

Sulphate (SO₄⁻²): Grasby et. al¹⁵ stated that the dissolved sulphates are found in water from the dissolution of sulphate minerals. Dissolved sulphates can also be derived from the oxidation of Pyrite and reduction forms of reduced sulphur. The domestic and industrial wastes tend to increase the concentration of sulphate¹⁶. Many Scholars, have reported that higher values are observed in summer and lower values in winter¹⁷. Panda et. al¹⁸, reported that the sulphate in water is due to domestic wastes, detergent, agricultural runoff and industrial effluent. The sulphate was recorded from 12 different spots and the values ranges from 0.01mg/l to 0.05mg/l, it is presented in table 9. Many scholars has reported that the

values are high in rainy season and very low in post rainy season, it is in agreement with the present studies.

Nitrate: Nitrate ion is part of the nitrogen cycle. Nitrate is the most abundant forms of dissolved nitrogen in water. Many scholars have reported that the concentration of nitrate ion increase in winter. It was also reported that the high concentration of nitrate in portable water is due to excessive use of agricultural fertilizers, sewage disposal industrial discharges, domestic effluent etc. The ion is estimated using a UV-Visible Spectrophotometer. The concentration of nitrate observed in the present study was below detectable level. It indicates that the nitrate (NO_3^-) containing water do not enter into Wah Kharai stream.

Chloride: Chloride is one of the major inorganic anions found in ground water. It originates in ground water from both natural and anthropogenic sources. The high concentration of chlorides in water indicates organic waste¹⁹, industrial waste and municipal waste²⁰ etc. High chloride content indicates heavy pollution. Chlorides in drinking water impart characteristic taste to it. Chloride concentrations of all the twelve water samples were never found far below the permissible limit of 250mg/l (BIS & WHO). The values are presented in table 11, it ranges from 0.01 to 0.02ppm.

Fluoride: The maximum permissible limits of fluoride in water according to WHO 1984 and Indian standard drinking water 1991 is 1.5ppm and the highest desirable limit is 1.0ppm. In the present study, fluoride contents in all the samples are below detectable limits. For the good health the permissible limits of fluoride is 0.0 to 0.04ppm²¹. The values are presented in table 12. It clearly indicates that the analysed water body is non- polluted.

Phosphate: Phosphate ions present in the free or in the combine state. It is the necessary elements for the growth of plants and animals. It plays an important role in DNA, RNA, ADP and ATP. Most of the available phosphorous to surface water are from sewage treatment plants and also from the use of industrial products like toothpaste, pharmaceuticals, detergents etc. The phosphate quantity in water may also increase due to runoff from the agricultural sites. The quantity of phosphate presents in all the water samples were below detectable level during the study.

Arsenic (As): Arsenic is much concern from the both environmental and human health standpoints. The quantity of arsenic in water may also increase due to industrial or agrochemical waste²². The inorganic forms of arsenic exhibit the highest toxicity level²³ while organoarsenicals are usually less toxic. It enters into the human body through ingestion, inhalation, or skin absorption and then it is distributed mainly in the lungs, liver, kidney and skin²⁴. In the early stage, it is very difficult to diagnose. The symptoms and signs of arsenic poisoning may be reduced if the water is portable and free from arsenic. Arsenic ingestion through food or water may have serious effects on the human cardiovascular system and both acute and chronic arsenic exposure may lead to heart failure^{25,26}. The arsenic quantity was below detectable level during the study.

Lead: Lead is highly poisonous in human body. It is always associated with health hazards like anemia²⁷ and reproductive effect^{28,29}. Lead poisoning may cause lower IQs and also behaviour changes in children. Some may have psychotic behaviour too. The concentration of children may disturb at any time. According to Indian standard drinking water specification 1999, the highest limit of lead in drinking water is 0.05ppm. There is no relaxation for maximum permissible limits of lead. The lead quantity was below detectable level during this study.

Cadmium: Cadmium is also highly poisonous element. Exposures to maximum contaminant level (0.005mg/l) of cadmium, it has the chronic potential to cause kidney, liver, bone and blood damage. Below the maximum contaminant levels of cadmium, the expected risk of health is not well known till date³⁰. It may directly affect the health of municipal solid waste recovery workers. The cadmium level may also be high in the agricultural areas where phosphate fertilisers are used. In the present study, the amounts of cadmium present in all the water samples were below detectable levels.

Chromium: Exposure to Chromium (VI) is highly carcinogenic to humans³¹. The current guideline value 0.05mg/litre has been questioned by the International community of scholars. In the present study, the amounts of chromium present in all the water samples were below detectable levels.

Iron: Iron is required in human body but its presence in drinking water is not desirable for

various reasons³². Large quantity of iron presence in water makes turbid, brownish and have different taste. The present study shows that the values are far below the permissible limits as prescribed by the WHO. It was transparent in colour during winter. Therefore, the water of this stream is not necessary for filtration, sedimentation etc. during the dry season. The values are presented in table 19.

Zinc: Zinc is used for galvanizing steel and all kinds of iron products. Zinc oxide is used in rubber as a white pigment. Water containing zinc at the range 3–5 mg/l tends to appear opalescent and develops a greasy film when boiled³³. Food poisoning is reported to the use of galvanized zinc containers in food preparation. Some of the specific symptoms are nausea, vomiting, diarrhoea, bleeding, abdominal cramps etc³⁴. Usually drinking water makes a negligible contribution to zinc intake. The quantity of zinc present in the present study is presented in table 20. Atomic absorption spectrometry is the most widely used method for the determination of zinc. Low concentrations of zinc in the range of 0.5 to 1.0 µg/l can be measured by chelating zinc with ammonium pyrrolidine dithiocarbamate and extracting it with methyl isobutyl ketone³⁵. Zinc is required in our body but the toxicity arises from the ingestion of excessive amounts of zinc salts particularly from the dietary supplement. For example, consumption of more than 500 mg of zinc sulphate, occurs vomiting. Fortunately, the values are presented in table 20 and zinc present in this stream was below detectable level.

Copper: Metallic copper is malleable, ductile and a very good thermal and electrical conductor. It is used to make electrical wiring, pipes, valves, coins, cooking utensils and also building materials. Some of the copper compounds are used in fungicides, algicides, insecticides etc. and form maximum complexes with hydroxide and carbonate ions. Copper (II) ion is the common species present in water as CuCO_3 at the ranges of pH 6–9.3³⁶ (Stumm & Morgan, 1996). The copper concentrations in surface water in an unpolluted zone of the River Periyar in India, ranged from 0.0008 to 0.010 mg/litre³⁷. Its concentration in running water tends to be very low and is widely vary as a result of variation in characteristics such as pH, hardness etc. The present study shows that the quantity of copper present in water is below detectable level and shown in table 21.

Iron, Zinc and Copper: These three elements are known as trace elements. These elements occur in natural system in minute quantity. The rapid industrialisation is one of the major

factors which enhance the concentration of trace elements in the environment. However, the main source and its tributaries are far from the industrial sites, therefore, the concentration of the three elements are below detectable level.

Alkalinity and Acidity: Alkalinity is the total measure of the substance in water that has the capacity of water to neutralise acid. In fact it is not a pollutant. It indicates the power of a solution to react with acid. Alkalinity has been shown significant variations between 2015 and 2016. The total alkalinity of all the water samples was found to be lower than permissible value. It was observed that the acidity remains constant between 2015 and 2016.

Biological Oxygen Demand (BOD): In 2015, one sample indicates that the BOD value was 0.0. And one sample in 2015 and two samples in 2016 indicates the value as 01.0 mg/l. These values are within the permissible limits as prescribed by WHO (1991).

Chemical Oxygen Demand (COD): Chemical Oxygen Demand was found to be 0.05 to 10.0 mg/l. The high value of COD indicates the presence of organic pollutants in water. It could be due to decompose grass, leaves.etc.

Discussion: The analysed result is presented in table 1-22. The results obtained from different locations are compared with drinking water standard. The temperature of the stream is influence by climatic conditions and the value ranged from 15.8 to 24.3C°. The minimum values were recorded in winter and maximum in summer. The temperature difference might be due to the depth of the stream and also differences between the collection times. The pH values ranged from 6.58 to 8.09, it was maximum 8.09 in the rainy season and minimum 6.58 in the winter. The values are within the permissible limits as prescribed by WHO, BIS and ICMR. The conductivity is mainly due to the dissolved ions liberated from the decomposed plants³⁸ and from the organic and inorganic waste³⁹. The conductivity of water is enhanced by the total dissolved solids. In the present study, the total dissolved solids are high during the rainy season and low in the winter consequently the conductance value is high in the rainy season and low in the winter. A significant variation of conductance values observed in different samples ranged from 38.0 to 211 μ Scm⁻¹. The high values may be due to various ions dissolve from the rock and soil. The turbidity values of all the twelve water samples ranged from 0.01 to 0.06NTU. The present study indicates that the values are within the

permissible limit of 5NTU. The TDS values ranged from 24.6 to 120ppm and the values are within the permissible limits described by BIS. The total TDS values observed in the present study might be due to soil erosion. The TDS values are also calculated by using the formula $TDS = 0.64 \times EC(\mu S/cm)$ where EC is the electrical conductivity. The direct measurement values and the values calculated by using the formula are almost equivalent. This indicates the similarity of theoretical and the experimental values. TDS values are low in the winter because almost all the dissolved solids are settled at the bottom of the stream. As a result the water body was much cleaned in the winter. In the present study, the salinity values ranged from 0.02 to 0.09ppt. Since the values are low, it does not have adverse affect in human body as well as in plants. Normally DO is higher in rainy season due to increased in aeration⁴⁰. In the present study, it was observed that the values ranged from 6.48 to 6.95ppm. The values are in agreement with the earlier reports⁴¹. The high organic substances deposition enhanced the natural oxidation as a result depletion of oxygen takes place when anaerobic bacteria take over the process of decomposition^{42,43}. Consequently, high value of BOD is expected. However, in the present study, the biological oxygen demand is very low; it indicated that the organic pollutants are significantly low in this stream. As a result the DO content in water is not disturbed. The values are within the permissible limits as prescribed by WHO. In the present investigation, the chemical oxygen demand is observed in the ranged of 05 to 10.0mg/l. The low value of COD also indicated that the content of organic pollutants is low in the water body. The observed values are still within the permissible limits. As a result, the aquatic life is not disturbed. The concentration of sulphate ions observed in the present study ranged 0.01 to 0.04ppm. It is within the standard permissible limit. Nitrate values obtained from 12 different spots are below detectable level. It does not have adverse effect in human physical condition. Many scholars have reported that the chloride value is always less than the sulphate. The values obtained in the present investigation are in agreement with other findings reported earlier. The values obtained are within the permissible limits. It clearly indicates that the water of this stream is free from pollution at the moment. The parameters like Fluoride, Phosphate, Arsenic, Mercury, Lead, Cadmium, Chromium, Iron, Zinc and Copper are below detectable level in all the seasons. These values are below the permissible limits prescribed by WHO. As a result, consumption of this stream water is absolutely harmless at present and also in the near future.

Conclusion: Many scholars have reported that the human activities have profound impacts on the environment. It may be mentioned clearly that the control of human activities to

prevent sewage entering into water body is the important step to keep water portable. The present study reveals that Wah Kharai stream is fit for drinking and can be used for other activities too. However, prevention is always better than cure. Therefore, educative programmes must be organised by scholars particularly by UCC community, head man of the village and also from the government agencies on the human activities particularly washing vehicles, washing clothes, discharging all types of waste to the stream. This will be relevant for the people inhabiting nearby stream and particularly UCC community. It may also be noted that the stream water is more acidic in winter nevertheless it is within the permissible limit prescribed by WHO.

Recommendations

- 1 Direct washing clothes, vehicles, utensils and taking bath should be avoided
- 2 Direct discharge of septic tank, sewage particularly from the hospitals and educational institutions should be avoided.
- 3 The UCC community and surrounding area people should be educated through workshop, seminar etc. for the benefits society.

Table 1. Value of Temperature

Location	Temperature					
	June	August	October	December	February	April
1	24.3	23.4	20.2	16.0	19.0	22.7
2	24.3	23.3	20.2	16.0	19.1	22.8
3	24.2	23.3	20.3	15.8	18.9	22.5
4	24.1	23.2	20.2	16.3	19.3	22.7
5	24.1	23.3	20.3	16.1	19.1	22.7
6	24.0	23.5	20.3	16.3	19.3	22.8
7	24.2	23.3	20.1	16.5	19.5	22.7
8	24.0	23.2	20.1	16.7	18.8	23.1
9	24.1	23.2	20.0	17.0	18.9	22.7
10	24.0	23.0	20.9	16.8	18.8	23.0
11	24.1	23.1	20.8	16.8	19.3	23.1
12	24.4	23.2	20.8	16.9	18.9	22.7

Table 2. Value of pH

Location	pH					
	June	August	October	December	February	April
1	7.27	7.54	7.51	7.41	7.21	7.24
2	7.30	7.84	7.74	7.43	7.29	7.96
3	7.36	7.85	7.91	7.60	7.37	7.79
4	7.05	7.92	7.66	7.42	6.93	8.00
5	7.11	7.93	7.62	7.26	6.99	7.25
6	7.18	7.93	7.61	7.32	6.76	8.00
7	7.18	7.88	7.55	7.54	7.69	7.77
8	7.17	7.97	8.09	7.69	6.58	8.05
9	7.25	7.87	7.80	7.62	7.21	7.69
10	7.33	7.87	7.00	6.93	6.60	7.65
11	6.89	7.77	7.21	7.10	6.63	7.66
12	6.81	7.96	6.96	6.77	6.54	7.69

Table 3. Value of Conductivity

Location	Conductance (μScm^{-1})					
	June	August	October	December	February	April
1	153	157	156	154	38.0	126
2	190	203	211	195	46.0	122.0
3	147	160	164	155	56.0	133.0
4	127	142	140	157	54.0	136.0
5	129	141	141	143	39.0	133.0
6	125	125	132	132	39.0	94.0
7	124	126	125	118	56.0	113.0
8	113	141	136	139	54.0	96.0
9	107	133	137	134	80.0	106.0
10	112	133	135	132	65.0	98.0
11	117	107	111	97	53.0	113.0
12	101	110	113	107	51.0	93.0

Table 4. Value of Turbidity

Location	Turbidity(NTU)					
	June	August	October	December	February	April
1	0.05	0.06	0.06	0.03	0.01	0.02
2	0.05	0.05	0.07	0.04	0.01	0.03
3	0.06	0.05	0.06	0.02	0.01	0.02
4	0.04	0.04	0.06	0.01	0.01	0.02
5	0.05	0.04	0.05	0.01	0.01	0.01
6	0.03	0.03	0.05	0.02	0.01	0.03
7	0.03	0.03	0.04	0.03	0.02	0.03
8	0.04	0.03	0.04	0.02	0.01	0.02
9	0.04	0.03	0.04	0.02	0.01	0.02
10	0.05	0.04	0.04	0.03	0.02	0.02
11	0.05	0.03	0.04	0.02	0.01	0.01
12	0.02	0.03	0.03	0.02	0.01	0.01

Table 5. Value of TDS

Location	TDS(ppm)					
	June	August	October	December	February	April
1	97.4	100.0	99.10	98.2	24.6	80.5
2	120.0	130.0	135.0	125.0	29.3	78.0
3	93.6	102.0	104.0	99.3	35.6	85.0
4	80.4	90.5	89.21	100.0	34.9	87.0
5	82.8	90.4	90.13	91.1	24.9	90.0
6	79.2	80.3	84.21	84.1	24.9	60.3
7	79.0	80.4	80.12	75.6	35.9	72.6
8	72.3	90.0	87.61	88.8	34.5	61.4
9	68.1	85.2	87.23	85.0	51.3	68.0
10	71.9	85.0	86.15	84.1	41.6	63.1
11	74.8	68.8	71.21	62.0	34.0	72.4
12	64.4	70.0	72.42	68.3	32.4	59.0

**Table 6. Value of TDS (Calculated value of Total Dissolved Solids by using the formula:
TDS = 0.64 x EC (μ S/cm))**

Location	TDS(ppm)					
	June	August	October	December	February	April
1	97.92	100.48	99.84	98.56	24.32	80.64
2	121.6	129.92	135.04	124.8	29.44	78.08
3	94.08	102.4	104.96	99.2	35.84	85.12
4	81.28	90.88	89.60	100.48	34.56	87.04
5	82.56	90.24	90.24	91.52	24.96	85.12
6	80.00	80.00	84.48	84.48	24.96	60.16
7	79.36	80.64	80.00	75.6	35.84	72.32
8	72.32	90.24	87.04	88.96	34.56	61.44
9	68.48	85.12	87.68	85.76	51.2	67.84
10	71.68	85.12	86.40	84.48	41.6	62.72
11	74.88	68.48	71.04	62.08	33.53	72.32
12	64.64	70.40	72.32	68.48	32.64	59.52

Table 7. Value of Salinity (ppt)

Location	Salinity(ppt)					
	June	August	October	December	February	April
1	0.09	0.07	0.08	0.07	0.05	0.06
2	0.08	0.08	0.06	0.06	0.02	0.07
3	0.09	0.08	0.08	0.08	0.03	0.08
4	0.08	0.07	0.07	0.05	0.04	0.07
5	0.09	0.06	0.09	0.06	0.04	0.07
6	0.08	0.08	0.07	0.07	0.03	0.06
7	0.08	0.07	0.08	0.07	0.03	0.07
8	0.07	0.08	0.07	0.06	0.04	0.06
9	0.07	0.07	0.06	0.05	0.05	0.06
10	0.09	0.06	0.07	0.06	0.04	0.07
11	0.08	0.07	0.06	0.06	0.03	0.05
12	0.08	0.06	0.07	0.05	0.03	0.04

Table 8. Value of Dissolved Oxygen

Location	Dissolve Oxygen (ppm)					
	June	August	October	December	February	April
1	6.95	6.85	6.75	6.69	6.70	6.75
2	6.90	6.75	6.69	6.55	6.64	6.70
3	6.92	6.80	6.75	6.49	6.54	6.81
4	6.80	6.72	6.68	6.48	6.55	6.80
5	6.84	6.75	6.78	6.50	6.52	6.81
6	6.85	6.73	6.80	6.55	7.58	6.80
7	6.82	6.74	6.78	6.60	6.69	6.82
8	6.80	6.78	6.75	6.65	6.66	6.75
9	6.80	6.78	6.70	6.68	6.73	6.72
10	6.81	6.75	6.76	6.71	6.72	6.69
11	6.85	6.81	6.60	6.48	6.51	6.83
12	6.78	6.75	6.72	6.70	6.78	6.88

Table 9. Quantity of Sulphate (SO₄⁻²)

Location	SO ₄ ⁻² (ppm)					
	June	August	October	December	February	April
1	0.04	0.03	0.03	0.03	0.01	0.03
2	0.03	0.05	0.04	0.04	0.01	0.03
3	0.03	0.04	0.03	0.02	0.01	0.02
4	0.04	0.04	0.03	0.03	0.01	0.02
5	0.04	0.04	0.03	0.04	0.01	0.04
6	0.03	0.03	0.03	0.02	0.01	0.03
7	0.03	0.03	0.02	0.03	0.02	0.03
8	0.04	0.03	0.01	0.02	0.01	0.02
9	0.04	0.03	0.04	0.02	0.01	0.02
10	0.05	0.04	0.03	0.03	0.02	0.02
11	0.05	0.03	0.04	0.02	0.01	0.03
12	0.02	0.03	0.03	0.02	0.01	0.03

Table 10. Quantity of Nitrate (NO₃⁻)

Location	Nitrate (NO ₃ ⁻)(ppm)					
	June	August	October	December	February	April
1	BDL	BDL	BDL	BDL	BDL	BDL
2	BDL	BDL	BDL	BDL	BDL	BDL
3	BDL	BDL	BDL	BDL	BDL	BDL
4	BDL	BDL	BDL	BDL	BDL	BDL
5	BDL	BDL	BDL	BDL	BDL	BDL
6	BDL	BDL	BDL	BDL	BDL	BDL
7	BDL	BDL	BDL	BDL	BDL	BDL
8	BDL	BDL	BDL	BDL	BDL	BDL
9	BDL	BDL	BDL	BDL	BDL	BDL
10	BDL	BDL	BDL	BDL	BDL	BDL
11	BDL	BDL	BDL	BDL	BDL	BDL
12	BDL	BDL	BDL	BDL	BDL	BDL

Table 11. Quantity of Chloride (Cl⁻)

Location	Chloride(Cl ⁻)(ppm)					
	June	August	October	December	February	April
1	0.012	0.012	0.012	0.011	0.01	0.011
2	0.01	0.011	0.011	0.01	0.01	0.011
3	0.01	0.012	0.01	0.01	0.02	0.01
4	0.011	0.01	0.01	0.012	0.01	0.01
5	0.01	0.01	0.011	0.01	0.02	0.01
6	0.011	0.013	0.01	0.01	0.01	0.011
7	0.01	0.01	0.01	0.012	0.01	0.011
8	0.01	0.011	0.01	0.01	0.01	0.011
9	0.012	0.01	0.01	0.01	0.012	0.01
10	0.01	0.012	0.011	0.012	0.01	0.011
11	0.01	0.01	0.011	0.01	0.01	0.01
12	0.01	0.01	0.01	0.01	0.012	0.011

Table 12. Quantity of Fluoride (F⁻)

Location	Fluoride (F ⁻)(ppm)					
	June	August	October	December	February	April
1	BDL	BDL	BDL	BDL	BDL	BDL
2	BDL	BDL	BDL	BDL	BDL	BDL
3	BDL	BDL	BDL	BDL	BDL	BDL
4	BDL	BDL	BDL	BDL	BDL	BDL
5	BDL	BDL	BDL	BDL	BDL	BDL
6	BDL	BDL	BDL	BDL	BDL	BDL
7	BDL	BDL	BDL	BDL	BDL	BDL
8	BDL	BDL	BDL	BDL	BDL	BDL
9	BDL	BDL	BDL	BDL	BDL	BDL
10	BDL	BDL	BDL	BDL	BDL	BDL
11	BDL	BDL	BDL	BDL	BDL	BDL
12	BDL	BDL	BDL	BDL	BDL	BDL

Table 13. Quantity of Phosphate

Location	Phosphate (ppm)					
	June	August	October	December	February	April
1	BDL	BDL	BDL	BDL	BDL	BDL
2	BDL	BDL	BDL	BDL	BDL	BDL
3	BDL	BDL	BDL	BDL	BDL	BDL
4	BDL	BDL	BDL	BDL	BDL	BDL
5	BDL	BDL	BDL	BDL	BDL	BDL
6	BDL	BDL	BDL	BDL	BDL	BDL
7	BDL	BDL	BDL	BDL	BDL	BDL
8	BDL	BDL	BDL	BDL	BDL	BDL
9	BDL	BDL	BDL	BDL	BDL	BDL
10	BDL	BDL	BDL	BDL	BDL	BDL
11	BDL	BDL	BDL	BDL	BDL	BDL
12	BDL	BDL	BDL	BDL	BDL	BDL

Table 14. Quantity of Arsenic

Location	Arsenic (As)(ppm)					
	June	August	October	December	February	April
1	BDL	BDL	BDL	BDL	BDL	BDL
2	BDL	BDL	BDL	BDL	BDL	BDL
3	BDL	BDL	BDL	BDL	BDL	BDL
4	BDL	BDL	BDL	BDL	BDL	BDL
5	BDL	BDL	BDL	BDL	BDL	BDL
6	BDL	BDL	BDL	BDL	BDL	BDL
7	BDL	BDL	BDL	BDL	BDL	BDL
8	BDL	BDL	BDL	BDL	BDL	BDL
9	BDL	BDL	BDL	BDL	BDL	BDL
10	BDL	BDL	BDL	BDL	BDL	BDL
11	BDL	BDL	BDL	BDL	BDL	BDL
12	BDL	BDL	BDL	BDL	BDL	BDL

Table 15. Quantity of Mercury

Location	Mercury (Hg)(ppm)					
	June	August	October	December	February	April
1	BDL	BDL	BDL	BDL	BDL	BDL
2	BDL	BDL	BDL	BDL	BDL	BDL
3	BDL	BDL	BDL	BDL	BDL	BDL
4	BDL	BDL	BDL	BDL	BDL	BDL
5	BDL	BDL	BDL	BDL	BDL	BDL
6	BDL	BDL	BDL	BDL	BDL	BDL
7	BDL	BDL	BDL	BDL	BDL	BDL
8	BDL	BDL	BDL	BDL	BDL	BDL
9	BDL	BDL	BDL	BDL	BDL	BDL
10	BDL	BDL	BDL	BDL	BDL	BDL
11	BDL	BDL	BDL	BDL	BDL	BDL
12	BDL	BDL	BDL	BDL	BDL	BDL

Table 16. Quantity of Lead

Location	Lead (Pb)(ppm)					
	June	August	October	December	February	April
1	BDL	BDL	BDL	BDL	BDL	BDL
2	BDL	BDL	BDL	BDL	BDL	BDL
3	BDL	BDL	BDL	BDL	BDL	BDL
4	BDL	BDL	BDL	BDL	BDL	BDL
5	BDL	BDL	BDL	BDL	BDL	BDL
6	BDL	BDL	BDL	BDL	BDL	BDL
7	BDL	BDL	BDL	BDL	BDL	BDL
8	BDL	BDL	BDL	BDL	BDL	BDL
9	BDL	BDL	BDL	BDL	BDL	BDL
10	BDL	BDL	BDL	BDL	BDL	BDL
11	BDL	BDL	BDL	BDL	BDL	BDL
12	BDL	BDL	BDL	BDL	BDL	BDL

Table 17. Quantity of Cadmium

Location	Cadmium (Cd)(ppm)					
	June	August	October	December	February	April
1	BDL	BDL	BDL	BDL	BDL	BDL
2	BDL	BDL	BDL	BDL	BDL	BDL
3	BDL	BDL	BDL	BDL	BDL	BDL
4	BDL	BDL	BDL	BDL	BDL	BDL
5	BDL	BDL	BDL	BDL	BDL	BDL
6	BDL	BDL	BDL	BDL	BDL	BDL
7	BDL	BDL	BDL	BDL	BDL	BDL
8	BDL	BDL	BDL	BDL	BDL	BDL
9	BDL	BDL	BDL	BDL	BDL	BDL
10	BDL	BDL	BDL	BDL	BDL	BDL
11	BDL	BDL	BDL	BDL	BDL	BDL
12	BDL	BDL	BDL	BDL	BDL	BDL

Table 18. Quantity of Chromium

Location	Chromium (Cr)(ppm)					
	June	August	October	December	February	April
1	BDL	BDL	BDL	BDL	BDL	BDL
2	BDL	BDL	BDL	BDL	BDL	BDL
3	BDL	BDL	BDL	BDL	BDL	BDL
4	BDL	BDL	BDL	BDL	BDL	BDL
5	BDL	BDL	BDL	BDL	BDL	BDL
6	BDL	BDL	BDL	BDL	BDL	BDL
7	BDL	BDL	BDL	BDL	BDL	BDL
8	BDL	BDL	BDL	BDL	BDL	BDL
9	BDL	BDL	BDL	BDL	BDL	BDL
10	BDL	BDL	BDL	BDL	BDL	BDL
11	BDL	BDL	BDL	BDL	BDL	BDL
12	BDL	BDL	BDL	BDL	BDL	BDL

Table 19. Quantity of Iron:

Location	Iron (Fe)($\mu\text{g/l}$)					
	June	August	October	December	February	April
1	BDL	BDL	BDL	BDL	BDL	BDL
2	BDL	BDL	BDL	BDL	BDL	BDL
3	BDL	BDL	BDL	BDL	BDL	BDL
4	BDL	BDL	BDL	BDL	BDL	BDL
5	BDL	BDL	BDL	BDL	BDL	BDL
6	BDL	BDL	BDL	BDL	BDL	BDL
7	BDL	BDL	BDL	BDL	BDL	BDL
8	BDL	BDL	BDL	BDL	BDL	BDL
9	BDL	BDL	BDL	BDL	BDL	BDL
10	BDL	BDL	BDL	BDL	BDL	BDL
11	BDL	BDL	BDL	BDL	BDL	BDL
12	BDL	BDL	BDL	BDL	BDL	BDL

Note: PHENANTHROLINE METHOD. It indicates that the iron present in the water sample is below 5 $\mu\text{g/l}$.

Table 20. Quantity of Zinc (Note : Below 0.05 $\mu\text{g/l}$)

Location	Zinc (Zn)($\mu\text{g/l}$)					
	June	August	October	December	February	April
1	BDL	BDL	BDL	BDL	BDL	BDL
2	BDL	BDL	BDL	BDL	BDL	BDL
3	BDL	BDL	BDL	BDL	BDL	BDL
4	BDL	BDL	BDL	BDL	BDL	BDL
5	BDL	BDL	BDL	BDL	BDL	BDL
6	BDL	BDL	BDL	BDL	BDL	BDL
7	BDL	BDL	BDL	BDL	BDL	BDL
8	BDL	BDL	BDL	BDL	BDL	BDL
9	BDL	BDL	BDL	BDL	BDL	BDL
10	BDL	BDL	BDL	BDL	BDL	BDL
11	BDL	BDL	BDL	BDL	BDL	BDL
12	BDL	BDL	BDL	BDL	BDL	BDL

Table 21. Quantity of Copper

Location	Copper (Cu)($\mu\text{g/l}$)					
	June	August	October	December	February	April
1	BDL	BDL	BDL	BDL	BDL	BDL
2	BDL	BDL	BDL	BDL	BDL	BDL
3	BDL	BDL	BDL	BDL	BDL	BDL
4	BDL	BDL	BDL	BDL	BDL	BDL
5	BDL	BDL	BDL	BDL	BDL	BDL
6	BDL	BDL	BDL	BDL	BDL	BDL
7	BDL	BDL	BDL	BDL	BDL	BDL
8	BDL	BDL	BDL	BDL	BDL	BDL
9	BDL	BDL	BDL	BDL	BDL	BDL
10	BDL	BDL	BDL	BDL	BDL	BDL
11	BDL	BDL	BDL	BDL	BDL	BDL
12	BDL	BDL	BDL	BDL	BDL	BDL

Note: (A rough test of copper was made by adding 10ml of sodium citrate solution and 2ml diethyldithio carbamate(2%) to 100ml of the water sample and comparing by eye in 100ml measuring cylinder with the untreated water. No brown colour indicates the absence of copper in the water sample.

Table 22. Random test of some important parameters which was not included in the Proposal

Parameters	2015		2016	
	Sample I	Sample II	Sample I	Sample II
Acidity(mg/l)	02.0	02.0	02.0	02.0
Alkalinity(mg/l)	14.0	06.0	12.0	16.0
Biochemical Oxygen Demand(mg/l)	-	01.0	01.0	01.0
Chemical Oxygen Demand(mg/l)	-	05.0	10.0	10.0

Note: BDL (Below detectable level)

References:

1. Guidelines for drinking water quality, World Health Organisation, Geneva, Vol. 2, 1999.
2. Guidelines for drinking water quality, World Health Organisation, Geneva, 1993.
3. I.L. Marr and M.S. Cresser, Environmental Chemical Analysis, International Textbook Co., Glasgow (1983).
4. D.F.S. Natusch and P.K. Hopke, Analytical Aspects of Environmental Chemistry, John Wiley and Sons, New York (1983)
5. S.E. Manahan, Environmental Chemistry, CRC Press, USA, 6th ed.(1984).
6. Eugene W. Rice, Rodger B. Baird, Andrew D. Eaton, Lenore S. Clesceri, 'Standard Methods for the examination of Water and Wastewater' 22nd edition, APHA, AWWA, WEF 2012.
7. Bhatt, S. D., Pathak, J.K., Himalayan Environment: Water quality of drainage basins, Shree Almora Book Depot, Almora, pp 318, 1992.
8. Pathani, S.S, Impact of changing aquatic environment on the snow froot of Kumaun Himalayas: Ministry of environment and Forest, New Delhi, pp53, 1995.
9. Gupta, Sanjay, Bhatnagar, M. K., Singh Raviraj and Bhatanagar Prachi, " Studies on Physico- Chemical parameters of Bansagar dam and Nearby area Madhya Pradesh, India, International Journal of Latest Research in Science and Technology. Vol 2(3) pp 20-22, 2013.
10. Panda, R.B., Pradhan, D and Pande, L. K, Water quality of the Brahmani River- An analytical study upstream, Mid stream, Down stream at Effluent Discharge point of Talcher Industrial complex, Orissa, India, Journal of Industrial Pollution Control 25(1), 1-6, 2009.
11. Anand Singh Bisht, Gulam Ali, D. S. Rawat and N, N, Pandey, Physico-Chemical behaviour of the three different water bodies of sub-tropical Himalayan Region of India, Journal of Ecology and the Natural Environment 5(12) 387-395, 2013.
12. R. Khare, S. Khare, M. henmical analysis of Ganga river water, Asian Journal of Biochemical and pharmaceutical Research 1, 232-239, 2011.
13. Srivastava, P.K., Mukherjee, S., Gupta, M. and Singh, S.K., Characterising Monsoonal Variation on water quality Index of River Mahi in India using Geographical Information system, Water Quality Expo Health, 2, 193-203, 2001.

14. Mahananda, M. R., Physico-Chemical analysis of surface water and ground water of Bargarh District, Orissa, India, *International Journal of Research and Review in Applied Sciences*, 2(3), 284-295, 2010.
15. Grasby S.E., Hutcheon, I. and Krouse, H.R., Application of the stable isotope composition of SO_4^{-2} to tracing anomalous TDS in Nose Creek, southern Alberta Sulphate, Canada, *Applied Geochemistry*, 12 (5) 567-575, 1997.
16. Trivedi, R.K and Goel, P. K. , 1984, Chemical and biological methods for water pollution studies, Environmental Publications, Karad.
17. Zare Gariz, A., Sheikh, V., and Sadoddin, A., Assessment of seasonal variations of chemical characteristic in surface water using multivariate statistical methods, *International Journal of Environment Science and technology* 8(3) 581-592, 2011.
18. Panda, R.B., Pradhan, D. and Panda L.K., Water quality of the Brahmani river – an analytical study upstream, midstream, downstream at effluent discharge point of talcher industrial complex, Orissa, India. *Journal of Industrial Pollution Control* 25(1) 1-5, 2009.
19. Thresh J.C., Beale J. F., and Suckling E. V., *The examination of water and water supplies* B. W. Taylor, London 1949.
20. Ownby C. R. And Kee, D.A.: Chloride intake Eric. *Proc, Cong. Grat Lakes*, 382-389, 1968.
21. Trivedi P., Bhajpal A. and Thereja S. Comparative study of seasonal variations in water. *Nature Sci.* 8, 4, 2010.
22. Bansal, S. K., Haldar, N., Dhand, U. K. et al. Phrenic neuropathy on arsenic poisoning. *Int. J. Dermatol.* 30, pp 304-306, 1991.
23. Food and Agriculture Organization (FAO). World Health Organization (WHO). *WHO Food Addit, Ser.* 18. 1983.
24. Fennel, J. S., and Stacy, W. K. Electrocardiographic changes in acute arsenic poisoning. *Ir. J. Med. Sci.* 150, pp 338-339, 1981
25. Goldsmith, S., and From, A. H. Arsenic-induced atypical ventricular tachycardia. *N. Engl. Med.* 303, pp 1096-1097, 1986.
26. Moore M. R., Haematological effects of lead. *Sci Total Environ*, 1988 (71) 419-431.
27. Wildt K. Eliasson R, Borlin M. Effect of occupational exposure to lead on sperm and semen In: Claebson T. W., Nordberg G.F. Sagar P.R., editors. *Reproductive and developmental toxicity of metals. Proceeding of joint meeting in Rochester. New York: Plenum press*, 279-300, 1983

28. Cullen M.R., Kayne R. D., Robin J. M., Endocrine and reproductive in men a social with occupation inorganic lead intoxication. Arch Environ Health. 1984(39) 431-440.
29. International Agency for Research on cancer. Some metals and metallic compounds. Lyon, 1980, 205-323 (IARC Monographs on the Evaluation of the Carcinogenic risk, of Chemicals to Humans, Vol 23).
30. [Http://www.granthaalayah.com](http://www.granthaalayah.com) (International Journal of Research - GRANTHAALAYAH)
31. International Agency for Research on Cancer. Chromium and nickel. Lyon, (IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Vol 49), 1990.
32. Trivedi et al. Comparative study of seasonal variation in water. Nature and science 8(4) 2010.
33. Cohen JM et al. Taste threshold concentrations of metals in drinking water. Journal of American Water Work Assoc., 52, 660-670, 1960.
34. Water Works Association, 52:660,1960. Elinder CG. Zinc. In: Friberg L, Nordberg GF, Vouk VB, eds. Handbook on the toxicology of metals, 2nd ed. Amsterdam, Elsevier Science Publishers, 664-679, 1986
35. International Organization for Standardization: Water quality—determination of cobalt, nickel, copper, zinc, cadmium and lead—flame atomic absorption spectrometric methods. Geneva, 1986 (ISO 8288:1986).
36. Stumm W, Morgan JJ (1996) *Aquatic chemistry*. New York(NY), Wiley Interscience.
37. IPCS (1998) *Copper*. Geneva, World Health Organization, International Programme on Chemical Safety (Environmental Health Criteria 200).
38. Sarwar, S, K. And Irfan-Ul-Majid., Abiotic features and diatom population of Wular lake Kashmir. Ecol. Env and Cons 3(3)121-128 (1997).
39. Wright, R, Seasonal variation in water quality of a West African river (R Jong in Sierra Leone) Revue d'Hydrobiologie Tropicale 15(3), 193-199 (1982).
40. Gupta, R.K., Sharma, M., Gorai, A.C. and Pandey, P.N., Impact of Coal Mining Effluents on the physico-chemical characteristics of Raja Tank, Jaria (Dhanbad). J. Freshwater Bio 8(2) 63-73, 1996.
41. Gupta, A. K. And Malhotra, R.S., Ecological studies on water mould of kurukshetra: in current trends in Limnology1: 47-64, 1991.
42. Das, S.M. High pollution in lake Nainital (U.P) as evidenced by biological indicators. Science and Culture 44: 236-237, 1978

43. Das. S.M. and Pandey, J., Pollution, Fish mortality and Environmental parameters in lake Nainital,. J. Bombay Nat. Hist. Soc 79: 100-109, 1980.
44. <http://www.marinebio.net>
45. [http://Science. nasa.govt/earth science/oceanography/physical ocean/salinity](http://Science.nasa.govt/earth%20science/oceanography/physical%20ocean/salinity).

1. Water source during rainy season



2. Water source during September - October





3. Water source during the dry season



UNIVERSITY GRANTS COMMISSION
NORTH EASTERN REGIONAL OFFICE
3RD FLOOR, HOUSEFED, RENTAL BLOCK - V
BELTOLA - SASISTHA ROAD
DISPUR, GUWAHATI - 781006, ASSAM
PHONE : 0361 - 2267721 (O)
FAX : 0361 - 2267056
Website : www.ugc.ac.in
E-mail : ugcnerohy@rediffmail.com
ugcnero@gmail.com

No. F.5-179/2014-15/MP/NERO/027

February, 2015

The Principal,
Union Christian College, Barapani, Umiyam Khwan, P.O. -U.C.C.- 793122, Ri-Bhoi Dist., Meghalaya. **10 FEB 2015**

Sub: Financial Assistance to Teachers working in the colleges for undertaking Minor Research Project (MRP) on 'The Economic..... in Khasi Hills'.

Sir/Madam,

With reference to the MRP submitted by Dr. JW Lyngskor, Department of Economics of your college for financial assistance under the above scheme, this is to inform you that the University Grants Commission has approved a grant of Rs 1,50,000/- (Rupees One Lakh and Fifty Thousand) only for undertaking the above research project for the items listed below:-

Recurring Items	Amount (Rs)	Non-Recurring Items	Amount (Rs)	Total (Rs)
Chemical and Glass Works	-	Books & Journals	50,000/-	50,000/-
Field Works and Travel	30,000/-	Equipments	40,000/-	70,000/-
Contingency including special needs	20,000/-			20,000/-
Any other items	10,000/-	Any other items	-	10,000/-
		Grand Total		Rs. 1,50,000/-

Terms & Conditions

- The Principal Investigator (P.I) is requested to submit acceptance certificate as per the format of the UGC Guidelines within 14 days from the date of issue of this letter.
- Date of implementation of project will be the received date of 1st instalment of grant.
- The Research Project has to be completed within a period of 24 months. No extension in tenure is permissible in any circumstances.
- The second instalment of grant 40% will be released on receipt of the progress report of the work done, utilization certificate item wise statement of expenditure duly certified by the Principal Investigator/ Registrar/ Principal/ Head of the Institution.
- The detailed terms and conditions of availing Minor Research Project (12th Plan) may be seen at www.ugc.ac.in
- The suggestions given by the subject experts (if any) are enclosed for the benefit of investigator.

(Dr. Mohammed Arif)
Joint Secretary

Copy to:-

- Dr. JW Lyngskor, Department of Economics, Union Christian College, Barapani, Umiyam Khwan, P.O. -U.C.C.- 793122, Ri-Bhoi Dist., Meghalaya.
- The Director, College Development Council, North Eastern Hill University, Umshing Mawknroh, Shillong 793022, Meghalaya.
- The Registrar, North Eastern Hill University, Umshing Mawknroh, Shillong 793022, Meghalaya.
- The Secretary to State Govt. of Meghalaya (Education Department), Shillong, Meghalaya
- The Accountant General, Govt of India (A&E), Meghalaya, Shillong - 793 001.
- The Director of Higher Education, Addl. Secretariat Building, 1st Floor, Shillong, Meghalaya.
- Guard File.

(Kishor Kumar)
Education Officer



UNIVERSITY GRANTS COMMISSION
NORTH EASTERN REGIONAL OFFICE
3RD FLOOR, HOUSEFED, RENTAL BLOCK - V
BELTOLA - BASISTHA ROAD
DISPUR, GUWAHATI - 781006, ASSAM
PHONE : 0361- 2267721 (O)
FAX : 0361 - 2267056
Website : www.ugc.ac.in
E-mail : ugcneroghy@rediffmail.com
ugcnero@gmail.com

No. F.5-392/2014-15/MRP/NERO/2262

The Principal,

Union Christian College, Barapani, Umiam Khwan, P.O. - U.C.C. - 793 122, Ri-Bhoi District, Meghalaya.

February, 2015

7 FEB 2015

Sub.: Financial Assistance to Teachers working in the colleges for undertaking Minor Research Project (MRP) on "Theoretical studies on the human health".

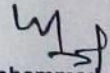
Sir/Madam,

With reference to the MRP submitted by Mr. Kerlang Kharchandy, Department of Physics of your college for financial assistance under the above scheme, this is to inform you that the University Grants Commission has approved a grant of Rs.1,30,000/- (Rupees One Lakh and Thirty Thousand) only for undertaking the above research project for the items listed below:-

Recurring Items	Amount (Rs)	Non-Recurring Items	Amount(Rs)	Total(Rs)
Chemical and Glass Works	-	Books & Journals	40,000/-	40,000/-
Field Works and Travel	20,000/-	Equipments	40,000/-	60,000/-
Contingency including special needs	30,000/-			30,000/-
Any other items	-	Any other items	-	-
Grand Total				Rs. 1,30,000/-

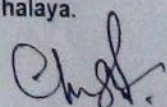
Terms & Conditions

1. The Principal Investigator (P.I.) is requested to submit acceptance certificate as per the format of the UGC Guidelines within 15 days from the date of issue of this letter.
2. Date of implementation of project will be the received date of 1st installment of grant.
3. The Research Project has to be completed within a period of 24 months. No extension in tenure is permissible in any circumstances.
4. The second installment of grant 40% will be released on receipt of the progress report of the work done, utilization certificate item wise statement of expenditure duly certified by the Principal Investigator/ Registrar/ Principal/ Head of the Institution.
5. The detailed terms and conditions of availing Minor Research Project (12th Plan) may be seen at www.ugc.ac.in
6. The suggestions given by the subject expert/s (if any) are enclosed for the benefit of investigator.


(Dr. Mohammad Arif)
Joint Secretary

Copy to:-

1. Mr. Kerlang Kharchandy, Department of Physics, Union Christian College, Barapani, Umiam Khwan, P.O. - U.C.C. - 793 122, Ri-Bhoi District, Meghalaya.
2. The Director, College Development Council, North Eastern Hill University, Umshing Mawkyntoh, Shillong 793022, Meghalaya.
3. The Registrar, North Eastern Hill University, Umshing Mawkyntoh, Shillong 793022, Meghalaya.
4. The Secretary to State Govt. of Meghalaya (Education Department), Shillong, Meghalaya
5. The Accountant General, Govt of India (A&E), Meghalaya, Shillong - 793 001.
6. The Director of Higher Education, Addl. Secretariat Building, 1st Floor, Shillong, Meghalaya.
7. Guard File.


(Kishor Kumar)
Education Officer



FD Dairy No:
Dated:

No.F.5-322/2015-16(MRP/NERO) **1452**

Date: **24 NOV 2016**

To
The Accounts Officer
University Grants Commission
North Eastern Regional Office, Guwahati - 781 006

to 24 Nov 2016

Subject: Release of Grants to Union Christian College, Barapani, P.O.: U.C.C. - 793 122, Ri-Bhoi District, Meghalaya for the year 2016-17 under Plan in respect of Minor Research Project entitled Environmental Justice Khasi Hills awarded to Baushaikupar Lyngdoh Mawlong, Department of Political Science

Sir/Madam,

I am directed to convey the sanction of the Commission for payment of grant of Rs. 1,10,000/- (Rupees One Lakh Ten Thousand) only as 1st Installment for the year 2016-17 towards the scheme of Minor Research Project to the Principal Union Christian College, Barapani, P.O.: U.C.C. - 793 122, Ri-Bhoi District, Meghalaya for the year 2016-17 (Plan / Non-Plan) expenditure to be incurred during 2016-17 as per details given below:

Sl. No.	Name of the Item	Allocation (Rs.) W	BE/RE (Rs.)	already sanctioned (Rs.) X	Grant now being sanctioned (Rs.) Y	Unspent balance if any / adj. (Rs.)	Total Grant Z=(X+Y)	Balance grant (Rs.) (W-Z)
(A) Recurring (General 31)								
(i)	Chemical & Glass Work	-		Nil	90,000/-	-	90,000/-	90,000/-
(ii)	Travel/Fieldwork Hiring	40,000/-						
(iii)	Contingency	35,000/-						
(iv)	Any Other Item (Investigators)	1,05,000/-						
(B) Non-Recurring (Capital 35)								
(i)	Books & Journal	20,000/-		Nil	20,000/-	-	20,000/-	Nil
(ii)	Equipment	-						
(iii)	Any Other Item	-						
Total:		2,00,000/-		Nil	1,10,000/-	-	1,10,000/-	90,000/-

- The sanctioned amount is debitible to Head of Account 3(D)50 [2552.00.131.02.01.31 & 35] and is valid for payment during the financial year 2016-17 only.
- The amount of the grant shall be drawn by the Education Officer (Drawing and Disbursing Officer), University Grants Commission on the Grant-in-Aid bill and shall be disbursed to and credited to grantee as above through Electronic mode as per the following details:

a.	Details (Name & Address) of Account Holder: Principal:	Principal, Union Christian College, Barapani, P.O.: U.C.C. - 793 122, Ri-Bhoi District, Meghalaya
b.	Account No:	10228762309
c.	Name & Address of Branch:	State Bank of India, Barapani, Shillong
d.	MICR Code of Branch	793002522
e.	IFSC Code	SBIN0002010
f.	Type of Account: SB/Current/Cash Credit	SB

- The grant is subject to the adjustment on the basis of Utilization Certificate in the prescribed Proforma submitted by the University / College / institution.
- The University / College shall maintain proper accounts of the expenditure out of the grant which shall be utilised only on approved items of expenditure.

Jameer
29/11/16

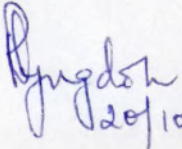
ST

21

To Whom It May Concern

This is to certify the Shri **Banshaikupar Lyngdoh Mawlong** was appointed **Joint Supervisor** for the ICSSR-NERC, Shillong, Minor Research Project, "Khasi Culture as a Model for Eco-Leadership: A Study into the Eco-Leadership Values and Ethics of Mawlong Protected Forest".

The said Minor Research Project was sanctioned in 2016 and was submitted to ICSSR-NERC in 2017.


20/10/17

Dr. Charles Reuben Lyngdoh
Project Supervisor



भारतीय सामाजिक विज्ञान अनुसंधान परिषद

पूर्वोत्तर क्षेत्रीय केन्द्र

INDIAN COUNCIL OF SOCIAL SCIENCE RESEARCH

NORTH EASTERN REGIONAL CENTRE

NEHU Campus, Shillong - 793022

Phone : 0364 - 2550436 (O)
2501817 (R)

Fax : 0364 - 2550428

e-mail : icssr_nerc@hotmail.com

website : www.icssrnerc.org

C J Thomas
Deputy Director

F.No.6 54/NERC/Pro-CRI/2016-362

August 10, 2016

Dr Charles Reuben Lyngdoh
Department of Political Science
Synod College
Jaiaw, Shillong - 793002

SANCTION ORDER

Subject: Project on "Khasi Culture as a Model for Eco-Leadership: A Study into the Eco-Leadership Values and Ethics of Raliang Sacred Groves".

Dear Dr Lyngdoh,

The Indian Council of Social Science Research North Eastern Regional Centre (ICSSR-NERC), Shillong considered the above mentioned research project proposal submitted by Dr Charles Reuben Lyngdoh, Department of Political Science, Synod College, Shillong.

The undersigned is directed to say that the Centre has sanctioned a grant-in-aid of Rs. 1,50,000/- (Rupees One Lakh) for the project which will be released in three installments as follows:

First Installment	:	Rs. 50,000/-
Second Installment	:	Rs. 50,000/-
Third Installment	:	Rs. 50,000/-
Total		Rs. 1,50,000/-

The First installment of the approved grant will be released after we have received the grant-in-aid bill (blank proforma enclosed) duly filled in. This may kindly be sent immediately.



SYNOD COLLEGE SHILLONG

MEGHALAYA - INDIA
PIN - 793002

Phone : 0364 - 2547219

Fax : 0364 - 2547489

E-mail: synodcollege@dataone.in

Website : www.synodcollege.com

NAAC Re-Accredited 'A' Grade

No. SC/MRP/2017/02

Dated the 24th June, 2017

To,

Banshaikupar Lyngdoh Mawlong
Department of Political Science
Union Christian College
Ri-Bhoi District, Meghalaya

Sub: Appointment Letter

Sir,

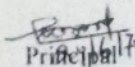
In accordance with the decision of the Major Research Project Committee taken on June 23rd, 2017, you are hereby appointed **Research Associate** for the Major Research Project entitled, "Culture and Environmental Sustainability: A Comparative Analysis of the Role of Culture in Sustainability in Meghalaya and Odisha" for a period of 23 months with effect from July 1st, 2017 to May 31st, 2019.

Your duties and responsibilities include:

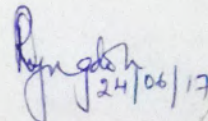
1. Identification of the project site
2. Recruitment of Research Assistant (if necessary)
3. Designing and preparation of questionnaire/interview schedule
4. Collection of data from relevant agencies/project site
5. Preparation of maps and surveys
6. Conducting interviews with all stakeholders
7. Compilation of Data
8. Preparation of draft project report
9. And undertaking any other work related to the project

For your services you will be paid an honorarium of Rs 4000/- per month and an allowance of Rs 250/- per day for local trips within Shillong, Meghalaya, an allowance of Rs. 500/- per day for local trips outside Shillong but within Meghalaya, and an allowance of Rs. 1000/- per day for trips outside the State of Meghalaya.

Thanking you,
Yours sincerely,


Principal

Synod College


24/06/17

Project Director
Major Research Project

Revathy Vishwanath
Assistant Director I/c (RP)
26716690

Indian Council of Social Science Research
(Ministry of Human Resource Development)
Aruna Asaf Ali Marg, New Delhi - 110067
EPABX: 26741849-51 Fax: 91-11-26741836

rdp@icssr.org

F.No. 02/260/ST/2016-17/RP

Dated: 30.03.2017

The Principal
Synod College,
Jaiaw, East Khasi Hills,
Shillong-793002, Meghalaya

Subject: Sanction of Responsive Research Project entitled "Culture and Environmental Sustainability: A Comparative Analysis of the Role of Culture in Sustainability in Meghalaya and Odisha to Dr. Charles Reuben Lyngdoh".

Dear Sir,

The Indian Council of Social Science Research (ICSSR) considered the above research project submitted by Dr. Charles Reuben Lyngdoh, Associate Professor and Head, Department of Political Science, Synod College, Jaiaw, East Khasi Hills, Shillong-793002, Meghalaya.

2. The Study, as proposed by the researcher/(s), is to be located at and financially administered by your institution as per the guidelines of this award.
3. The ICSSR has sanctioned a grant-in-aid of Rs. 7,00,000/- (Rupees seven lakh only) for the above research project and the grant will be released as follows:

First installment:	Rs.	2,80,000/-
Second installment:	Rs.	2,80,000/-
Final installment:	Rs.	1,40,000/-
Total	Rs.	7,00,000/-

* The break-up budget approved by the ICSSR of Rs. 7.00 Lakh is enclosed.

Revathy v

Cont'd.. 2/-



C J Thomas
Deputy Director

F.No.6.60/NERC/Pro-BLM/2017-601

January 11, 2018

Mr Banshaikupar Lyngdoh Mawlong
Department of Political Science
Union Christian College
Umiam Khwan, Ri Bhoi District
Meghalaya -793122

SANCTION ORDER

Subject: Project on "National Integration vis-à-vis Ethnic Nationalism: A Study into the Multicultural Society of Rural Khasi and Jaintia Hills"

Dear Mr Mawlong,

The Indian Council of Social Science Research North Eastern Regional Centre (ICSSR-NERC), Shillong considered the above mentioned research project proposal submitted by Mr Banshaikupar Lyngdoh Mawlong, Department of Political Science, Union Christian College, Ri Bhoi District, Meghalaya.

The undersigned is directed to say that the Centre has sanctioned a grant-in-aid of Rs. 1,50,000/- (Rupees One Lakh) for the project which will be released in three installments as follows:

First Installment	:	Rs. 50,000/-
Second Installment	:	Rs. 50,000/-
Third Installment	:	Rs. 50,000/-
Total		Rs. 1,50,000/-

The First installment of the approved grant will be released after we have received the grant-in-aid bill (blank proforma enclosed) duly filled in. This may kindly be sent immediately.



FD Diary No. 4800
Dated: 25/8/2017

No. F. 5- 177/2014(HRP)

NER

8 SEP 2017

The Under Secretary (FD-III),
University Grants Commission,
Bahadur Shah Zafar Marg,
New Delhi-110002.

Sub:- Release of Grants-in-aid to **Union Christian College, Barapani, Dist.East Khasi Hills, Meghalaya., Meghalaya (affiliated to North- Eastern Hill University, Shilong , Meghalaya)** for the year 2017-18 under Revenue in respect of Major Research Project entitled **"The Stone Age Culture of Khasi-Jaintia Hills of Meghalaya: An Archeological Study"** awarded to **Dr. MARCO MITRI, Deptt. of History, Tenure of project from 1/7/2015 to 30/6/2018.**

Sir,

I am directed to convey the sanction of the University Grants Commission for payment of grant of **Rs.2,96,400/- (Rupees Two lakhs ninety six thousand four hundred only)** as **Second Installment** for the year 2017-18 towards Major Research Project to the **Principal, Union Christian College, Barapani, Dist.East Khasi Hills, Meghalaya., Meghalaya** for the Revenue expenditure to be incurred during 2017-18.

S.NO	Name of the Item	Amount allocated	Head of Account	Amount Released	Amount Being Released	Total grant
		RS.		RS.	RS.	RS.
(1) Non- Recurring						
(i)	Books & Journals	30,000/-	3.(F) (i).35	30,000/-	-----	30,000/-
(ii)	Equipment	2,50,000/-		2,50,000/-	-----	2,50,000/-
(2) Recurring						
(i)	Honorarium	-----		-----	-----	-----
(ii)	Project Fellow @Rs.14000/- p.m. +HRA	3,92,000/- 84,000/-		2,52,000/-	1,00,800/-	4,28,400/-
(iii)	Contingency	1,50,000/-	3.(F) (i).31	75,000/-	60,000/-	1,35,000/-
(iv)	Hiring Services	50,000/-		25,000/-	20,000/-	45,000/-
(v)	Travel/ fieldwork	1,00,000/-		50,000/-	40,000/-	90,000/-
(vi)	Overhead	70,400/-		70,400/-	-----	70,400/-
	Total	11,26,400/-		7,52,400/-	2,96,400/-	10,48,800/-

P.T.O

GRANT AGREEMENT LETTER

May 10, 2018

Dr. R. M. Manih
Principal
Union Christian College
Umiam Khwan, Shillong
Ri Bhoi District
Meghalaya Post Code-793122
India

Dear Dr. Manih:

On behalf of the United Board, I am pleased to inform you that the Board of Trustees has approved the following grant for **Union Christian College** for the academic year 2018-2019. Please note that only this proposal listed below was selected for funding:

Culture-Religion Interactions among the Tribes of North East India

This project aims to study the concepts and contexts of the different cultures and religions among the tribes of Northeast India. Northeast India is comprised of eight states and is characterized by the living together of multiethnic, multicultural and multireligious communities. Comprised of a field study across the different states and two colloquia for academicians, subject experts and stakeholders in the region, this project will survey the numerous indigenous heritages, reflect on the different forms of their coexistence, and learn from them lessons for peaceful living.

US\$ 11,660

The grant is available after July 1, 2018, upon written request, subject to evaluation of the request date relative to the project schedule, and pending receipt of a signed copy of this letter, which constitutes the grant agreement. For multi-year projects, approval for each year as a simple addendum to this agreement subject to review of a progress report and other terms indicated herein is required.

Please sign, keep a copy, and return this grant agreement together with a written request for the grant.

Regarding the above grant, **Union Christian College** agrees that:

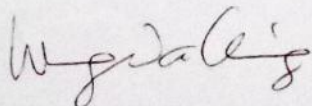
1. The grant will be used only for the project described in the request.
2. The grant will be used according to the budget submitted in the grant proposal and will not be expended for any other project without prior approval, in writing, by the United Board. The United Board staff will evaluate the project work schedule and depending on the circumstances agree to a reasonable timing for the disbursement of

funds.

3. You are encouraged to announce this grant, and we ask to review any written materials relating to it prior to release. We also request that the United Board's support be acknowledged in any publication and activities including conference, workshop and seminars concerning this project. Acknowledgement must use the full name of the *United Board for Christian Higher Education in Asia* while subsequent reference can be to the *United Board*. Name and logo should be used according to the guideline in www.unitedboard.org.
4. If any part of the grant is not expended for the project as described in the proposal, the grantee institution will notify the United Board. In such a case, the United Board has the right to change the terms or cancel the grant, and the grantee institution agrees to return any unexpended funds. U.S. Internal Revenue Service regulations, which govern the United Board's charitable status and allow the United Board to receive tax-deductible contributions in the U.S., expressly prohibit the use of grants for non-charitable purposes.
5. Institutional staff, who carry out the project, will keep detailed records of activities, rationale and outcome of these activities, as well as expenses incurred to facilitate the reporting process.
6. The United Board may monitor the progress of the project funded by the grant; discuss the project, implementation, and finances with representatives of the grantee institution; and review financial records and other material connected with the project. The United Board, at its sole discretion, may elect to terminate or not fund subsequent years and will not be held liable for any damages resulting from its decision.
7. A report for each grant will be sent to the United Board upon completion of the project, but no later than **July 31, 2019**. The report will include both narrative and financial sections and follow United Board suggested report format to the extent relevant.
8. For multi-year projects¹, an annual progress report, and a second/third year work plan with an updated budget as applicable, are to be submitted by April 30 of each year. The second/third year grant is available upon the return of a signed addendum for the corresponding year subject to the terms listed herein.
9. The grantee institution will comply with the USA Patriot Act and U.S. Presidential Executive Order 13224, which prohibit funding and the provision of resources and support for individuals and organizations associated with terrorism and/or drug trafficking. It is the legal responsibility of the grantee institution to ensure compliance with these laws.

If **Union Christian College** agrees to the terms of this grant as described above, please sign and return this letter to the United Board.

Sincerely yours,



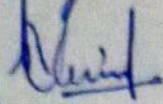
WONG Wai Ching Angela, Ph.D.
Vice President for Programs

¹ For multiyear projects granted in 2017-18 or before, submission of an interim report and a brief proposal with an update budget for the next phase of the project is required by December 31; for multiyear projects granted from 2018-19 onward, submission of an annual report with an update budget and a new year plan are required by April of the first second year after the date of award.

Agreed to and accepted by Union Christian College:

Date: 17th May 2018

Signature:



Title:

PRINCIPAL
Principal
Union Christian College
Umiam Khwan
Bhoi District, Meghalaya



Cc:

1. Mr. Bانشaikupar Lyngdoh Mawlong, Project Coordinator, Internal Quality Assurance Cell
2. Dr. J. P. Marak, Joint Project Coordinator, Internal Quality Assurance Cell
3. Rev. Maher Spurgeon, Regional Programs Consultant, United Board for Christian Higher Education in Asia